

The Introduction of Problem Based Learning to Students through A Computer Based Education Module

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Introduction

This paper describes the development of a computer-based module designed to introduce students in a range of disciplines to problem-based learning (PBL) and its relevance to their professional practice. The first two sections of the paper explain our choice of PBL and the decision to use computer-based education as a medium. The next section looks at the module and how it instantiates our reasoning. The final sections describes the design process and how this became a valuable exercise in problem-based learning.

The authors of this paper are University lecturers who have collaborated as a sub-group of the Teaching Reflection and Collaboration (TRAC) venture, a cross disciplinary staff development project co-ordinated by the Queensland University of Technology's Academic Staff Development Unit.

The group's members were concerned that as professionals, university graduates will be continuously challenged by unique situations which are ill-defined, for which they will have no previous experience and which will not necessarily have one clear solution. Consequently the situations they find themselves in will defy predefined solutions and require a self-directed response based on an analysis of contextual factors. It was considered that a PBL approach may be one way of encouraging students, particularly first years, to be self-directed and independent in their learning. To this end we examined the literature on PBL and investigated how we might develop a joint project that would introduce the concepts of PBL to students in a variety of disciplines for use by academics using PBL in their courses.

Educational Objectives

The authors come from a variety of disciplines which include law, nursing, interior design and language and literacy. Despite this, our educational objectives overlap to a significant extent. The major educational objectives that we targeted in our project are as follows:

- The development of students' decision making skills. This involves students becoming familiar with a complex set of skills that are used to make and implement a decision in order to meet a client's (or patient's) goals. This was seen as an essential aspect of professional practice (Ramsden,1992:50).

- The development of students' effective self-directed learning skills. Barrows (1986) states that the skills of self-assessment and self-directed learning allow students to become aware of their own personal learning needs and to locate and utilise effectively appropriate information sources.
- Increased student motivation for learning resulting from the relationship of the learning experience to real life situations and future professional practice. A number of researchers in education agree that concepts need to be grounded in experience and practice which enhances motivation and leads to a deeper approach to student learning (Laurillard, 1993; Barrows, 1986; Ramsden, 1992).
- Development of students' abilities to structure and integrate knowledge. In order to facilitate recall and application of knowledge students should be encouraged to develop the ability to structure and integrate the knowledge they acquire throughout their university education.
- Development of students' ability to reflect on their learning experience thereby learning through analysis and self-awareness (Kolb; Boud).

"...academic teaching must address both the direct experience of the world, and the reflection on that experience that will produce the intended way of representing it." (Laurillard, 1993: 29)

Rationale for Choosing a Problem Based Learning Approach

PBL is a way of constructing and teaching courses using problems, rather than information delivery, as the stimulus and focus for student activity and learning (Boud and Feletti, 199*). PBL courses start with problems and develop students' acquisition of knowledge and skills through the use of these problems. Rather than being passive receivers of information, students are expected to become active learners in control of, and responsible for, their own learning (Little and Ryan, 1988).

The distinction between PBL and problem solving is often a difficult one to make. Checkland (1981) distinguishes usefully between what he terms 'hard' systems thinking and 'soft' systems thinking. Hard systems thinking has a particular solution or goal to be achieved and is goal-directed and highly structured. There is often only one 'correct' solution. Soft systems thinking on the other hand, requires a more open approach with the professional defining and redefining the problem and then weighing up the possible options. PBL is more closely akin to soft systems thinking.

The authors considered that PBL has a number of characteristics which meet our educational objectives (Blunden).

- Problems become tools for learning. Through the use of problems students are exposed to the various stages of problem solving and practise their problem solving skills whilst they acquire substantive knowledge.

- Students are active participants rather than passive recipients in their learning process. PBL enhances student learning through their involvement and the use of real life situations which contextualise knowledge.
- By using 'real life' problems PBL relates the educational environment to future professional practice which provides strong motivation for learning.
- Students organise and structure the facts of their problem. This process helps develop their decision making and information gathering skills and, where simulated clients' are used, their communication skills.
- Students decide the direction of their enquiries and acquire substantive knowledge through self-directed study rather than through the lecture method. The expanding knowledge base of most professions means that it is more important for students to be able to learn quickly, effectively and independently when they need to rather than to have assimilated knowledge which will soon be out of date (Barrows, 1986).
- The development of greater student autonomy means that the instructor becomes the facilitator of the process rather than the source of knowledge imparted to the students.
- PBL encourages self reflection skills through analysis of the decision making process.
- Students develop an awareness of the importance of communication skills (e.g. active listening skills and interviewing skills) through working in groups and investigating client needs.

Computer-Based Education as an aid to Problem-Based Learning

This project utilises CBE to assist students to explore the principles of PBL. The decision to use computer technology, a "non-traditional" method of instruction (Conrick, 1993), presented both the authors and the computer programming specialists involved in the project with certain challenges which are explored in this section of the paper.

Given the far-reaching changes occurring in universities throughout Australia, including fiscal constraints and increasing numbers of students in many courses, university lecturers need to be proactive in developing new strategies which will meet changing demands without conflicting with established "academic values" (Laurillard, 1993). CBE has been acknowledged as a useful adjunct to learning which supports other teaching strategies (Cohen and Dacanay, 1994; Howard, 1987; Smyth, 1987; Simonson and Thompson, 1990). The authors accept Laurillard's (1993) contention that the use of new technology should improve the quality of teaching and learning, not just open up access to new information and experiences. The authors see CBE as a useful tool but do not consider it can replace the need for staff/student interaction in order to promote critical thinking and reflective practice. For these reasons the present module is not designed as a discrete unit but will be incorporated into established courses.

Although our decision to utilise CBE posed difficulties to some members of the group because of its unfamiliarity, discussion revealed a number of potential advantages.

- CBE expands the learning environment beyond the facilitator and the traditional classroom.
- It allows for different learning styles (Birch, 1986).
- It supports the application of principles of adult learning such as self-direction (Simonson and Thompson, 1990).
- It provides flexible access with regard to student times and workloads.
- By providing students with the ability to self-pace their learning it recognises that differences in background and levels of experience with decision making will influence time needed to complete the module.
- The mobility of the medium benefits distance education and part-time students and staff.
- CBE can foster computer literacy and a positive approach to new technology.
- By its interactive nature CBE encourages active learning (Birch, 1986).
- The potential to work in groups fosters collaborative learning.
- Immediate feedback can be provided.
- CBE provides students with a safe learning environment in which they can experiment with new skills.

The Structure of the Computer-Based Education Module

This module presents a generic situation designed to introduce students from any discipline to the principles of PBL.

The module consists of:

- an introduction to PBL;
- a hypothetical situation with which the student interacts;
- points of reflection requiring students to consider the processes they are engaged in; and
- a summary of possible solutions and their rationale.

The hypothetical situation selected involves an everyday occurrence in a university student's life. It was chosen to highlight to students that they possess and use the

necessary decision making skills implicitly throughout their lives. By reflecting on the process and thereby making it explicit, we hope the students will transfer these skills to discipline-specific situations in a confident and informed manner.

The process is divided into three stages which reflect the steps involved in PBL identified in the literature (e.g. Engel, 1982; Birch, 1986). These are:

1. Identifying facts and formulating an understanding of the problem.
2. Seeking information and synthesising the facts in light of the situation to identify possible options.
3. Reassessing possible options through consideration of the tangible and personal aspects of the problem to achieve a "best fit".

One of the major hurdles we perceived in utilising CBE in conjunction with PBL was the inability to avoid linear progressions through tasks, which in reality, are not necessarily carried out in sequence. To overcome this difficulty "loops" have been designed and included to ensure that the student can in fact make choices and move along paths that we, as mentors, deemed to be inappropriate at a particular time, e.g. offering options prior to gaining understanding of the issues involved. Students are then guided back to the central path.

To avoid the student as a novice "problem solver"/decision maker becoming lost in a maze of information and possible choices, the programme operates as a three tiered structure: The Directive, The Explorative and The Reflective.

1. The Directive

The student is given direction on how to use the programme and to move information between screens eg. type in, click to notepad.

2. The Explorative

The student interacts with the data presented and makes decisions on how to proceed.

3. The Reflective

The student reflects upon and evaluates the decisions they have made and the information given. Screens are inserted to provide the students an opportunity to stop and reconsider and to record their decisions.

The authors have deliberately incorporated planned stages of reflection into the module so that deeper learning through "interpretation and categorisation" of material could take place (Laurillard, 1993). It was considered important to avoid suggesting that a student's choice was right or wrong. Nevertheless feedback is given throughout the module on the appropriacy of certain choices in light of the information available (Simonson & Thompson, 1990). This also reduces the risk of the learner becoming frustrated through lack of direction. Following completion of the module, the student may read and evaluate the "solutions" of three other people and compare the reasons

given. This reinforces the student's awareness that there are many ways of approaching professional problems.

Important in the module's design is the graphic presentation of the hypothetical situation and the PBL process. It is critical to achieve optimal screen presentation in computer based instruction (Simonson & Thompson, 1990) as the "...screen is the primary interface between the user and the computer" (Dreher & Caputi, 1992). Due to the potential for "computer anxiety" by inexperienced users (Simonson & Thompson, 1990) it is important that attention is given to the novice and that the programme is "user friendly". To ensure that the module addressed these points user testing was incorporated into the design process.

The authors used a number of strategies to ensure that students are active participants in the learning process. In order to overcome the danger of directing students in making required choices, alternatives are depicted as jigsaw pieces in a selection of colours thereby neutralising them graphically. This is in contrast to traditional multiple choice or true/false questions which may "lead" students or encourage guesswork. Students are also required to categorise and evaluate information by typing their responses to a notebook embedded in the programme. They may recall the information entered to clarify particular points at a later stage in the process. This encourages students to reflect on the decision making activities they have undergone.

In order to enhance the students' interpersonal skills and to allow them to benefit from discussion of the processes involved in professional decision-making, it was decided that, where possible, they should work through the module with a partner or partners. The inclusion of the notebook also allows students to record and keep their own notes and selected information. This can be used in subsequent tutorials to address any queries or as a basis for wider discussion. Such personalisation of the program simplifies its inclusion into existing courses and makes it easier for students to relate the input to their own area of study.

Concluding Reflections

The development of the module became an interesting example of PBL processes as the authors came to the task from a range of discipline backgrounds and with different levels of experience in PBL and CBE. Our first task, therefore, and one of the most stimulating aspects of the project, was to define what we meant by problem-based learning and what we wanted to achieve by working together on the module and using computer technology. While membership of the TRAC group indicated a common commitment to the concept of Problem-Based Learning, discussion soon established that we had rather differing views of the processes entailed and how best the necessary skills and understanding could be developed in our students and incorporated into current programs. Colleagues in the law faculty, for example, were interested in the potential of PBL as a means of developing students' skills in assessing legal information. Finding the right section of the act or an appropriate legal precedent is crucial to the decision process. In language education, on the other hand, the emphasis was also on developing awareness of teaching/learning strategies and the potential impact of experiential learning on subsequent teaching practice. In the classroom, facts are often less clear cut and decisions may be based on an assessment of affective, linguistic, and contextual factors. Such different

perspectives gave rise to debate on whether to adopt a problem-based or problem-solving approach. In the end, we decided on the term *problem-based* because, for many of the issues professional practitioners face, finding a solution is only part of the process which also requires evaluating the wider context and exploring the impact of the proposed solution on other aspects of the clients' lives. The term *problem-solving* does not always capture this necessary complexity.

In developing the module we, therefore, sought to create a program in which students work at two levels: they engage actively with the simulated problem and then, at certain stages in the process, draw back and reflect on what they have done and why they have made the choices they have. This change of focus is signalled relatively unobtrusively but, we hope, effectively by a change in screen colour and layout.

Another concern of the group was whether a CBE module could be flexible enough and interactive enough to capture the essence of PBL with its emphasis on interpersonal skills and contextualised learning. For many, the decision to opt for CBE marked a change of practice and a desire to develop greater personal computer literacy. Our lack of familiarity with the medium certainly made the design process more difficult (Laurillard 1993) but it also made us very conscious of the potential difficulties the module might pose for students unfamiliar with PBL and/or CBE. One of our goals, therefore, became to develop a user-friendly interface which, in addition to exploring PBL, would encourage students in their use of computers as learning tools and enhance their understanding of the technology. Thus the computer literacy objective developed in the course of the project as we became more aware of the potential of CBE and more confident in our ability to use it rather than have it control us.

The group experience in creating the module also confirmed the value of cooperative learning as a means of supporting change and overcoming the resistance this so often provokes (Fullan 1992). As a group we are able to achieve outcomes which would have been more difficult working in isolation. Some of us, for example, were text-based in our orientation and had trouble visualising the program in terms of screens on the computer. Others, fortunately, could work with boxes and flow charts and create an overview of the structure of the module and the various pathways through it. This was enormously helpful not only in clarifying the options we were creating, but also in communicating our requirements to the CBE staff whose difficult task was to translate often tentative ideas into the computer medium. Again, the dialogue this process required and the feedback made available by more experienced colleagues allowed all of us to develop a better understanding of PBL and the potential of CBE as an increasingly flexible teaching/learning tool.

A further challenge which gave rise to considerable debate was the creation of the scenario. We were immediately conscious of the danger of stereotyping/simplification and also discussed issues of gender, ethnicity and social equity before settling on Robert and his work/study dilemma, a topic we felt most students could empathise with, irrespective of their course of study. The discussion showed that different schools have different concerns. In some areas, for example, male dominance was an issue and the decision to make the client male was designed to reduce the power difference between client and professional and to break down dependency stereotypes.

Another interesting cross disciplinary learning experience has been the discussion to clarify the individual author's meanings for the text proposed in designing the scenario and the instructions to students so that these do not pre-empt their decision-making. Again interaction with colleagues on such issues has been one of the very real personal benefits gained in the process of developing the module.

This paper explores the development of a computer-based module introducing problem-based learning for use across a range of disciplines. Our experiences have suggested that considerable benefits are to be gained from such a cross disciplinary approach for both academics and their students.

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